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ABSTRACT

A telematics and electronic communication task group examines technology's influence on the educational process as well as the physical classroom, and the needs and concerns these new technologies bring to architects and educators in designing an adaptable classroom. Technology and the classroom are examined in the following areas: the use of television; microcomputers and computer terminals; power and communication cable distribution; voice and data distribution; heating and air conditioning needs; acoustics; lighting; space configuration; furniture requirements; and security issues. (GR)

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ADDRESSING WAYS AND MEANS OF REDUCING COSTS IN THE DESIGN AND DELIVERY OF EDUCATIONAL FACILITIES

EF 005 458

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TELEMATICS AND ELECTRONIC COMMUNICATION AND THEIR EFFECT ON EDUCATIONAL SPACE

COMMITTEE ON ARCHITECTURE FOR EDUCATION
THE AMERICAN INSTITUTE OF ARCHITECTS

TELEMATICS & ELECTRONIC COMMUNICATION TASK GROUP
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TELEMATICS AND ELECTRONIC COMMUNICATION AND THEIR EFFECT ON EDUCATIONAL SPACE

As technology makes more and more advances, we are constantly made aware of the changes that may take place and are taking place in the educational environment.

In most instances, we are faced with electronic devices in an existing environment that must be adapted for use with the new technology. In doing so, we not only affect the environment, but the new technological devices as well.

We are faced with such rapidly changing technology that it seems we are always "catching up" or adapting to it. We spend so much time learning about the "new" electronic advances, that in many cases we lose sight of the future. We, as planners, are faced with designing environments that are as adaptable and flexible as possible to meet the changing requirements of our ever-changing technologies.

The challenge that we face seems dwarfed when one considers the effect these changes have on the educational process. These new electronic changes can have a very profound effect on the "place" of education.

Electronic communication can make it possible for students to be taught in areas other than the "schoolhouse." Two-way T.V., computer terminals, microcomputers, radio, satellite distribution, audiovisual cassettes, VCR and video disks can allow the "schoolhouse" to expand to the community, state, country and world.

Now that the "schoolhouse" has expanded to the world, we have to bring these concepts back to terms that are of immediate need and concern to architects and educators. What effects will there be on our present schools and those in the near future?

By analyzing the items listed above, we can identify some of the effects that they will have on our educational space.

Conference learning, distance learning, and individual independent study, as well as the type of equipment used, affect space size, location and environmental conditions relative to power distribution, lighting, acoustics, and heating and cooling.

Television:

T.V. can be utilized in the classroom in groups or in smaller spaces for small groups or individuals. As two-way T.V. advances, the possibility of its use in the educational area is enhanced.

A school can be connected by T.V. to other schools, libraries, businesses, stores and other areas of the community and, by the use of satellite communication, with the world.

Each classroom can be equipped with a T.V. in order to allow for groups of 25-30 to view the lecture, lesson or educational film.

With the addition of video disks or video cassettes, and VCRs, instructions, educational films and other data can be viewed on the T.V. screen.

Used in combination with the telephone, the T.V. monitor can become a tool for conferences and two-way communication that can be used by individuals or groups.

Data can be retrieved over the monitor from computers at distant locations. The "encyclopedia," as well as unlimited information, will be accessed through the T.V. when it is used in this manner.

Two-way T.V. can allow for conference learning of various sized groups from 1 to 100+.

Microcomputers & Computer Terminals:

The microcomputer and remote terminal presently being utilized in schools throughout the country has had a significant impact on not only the educational process, but directly and indirectly on the physical environment.

The most common uses are in groups as "labs" or individual units in a classroom or library media center.

The microcomputer in conjunction with a telephone modem can allow for education to take place in the home while originating in the school.

A terminal can also be attached to a central computer allowing students to use the individual micro to gain access to various pre-programmed instruction in any of the subjects taught in the school or outside the school. Programs such as history, English, math, etc., can be put into the computer and the student can access the program either during class time or as extra credit after school

hours. Extending the idea of the telephone modem, it might be possible for students to access the school computer for after school instruction or research.

Presently, at the college level, there are large laboratory groups of terminals that are networked to a central computer to which the student can gain access for instruction, information and testing. This gives added time to the student for data retrieval without needing direct contact with the instructor.

At the junior high and high school levels, the laboratories are made up of microcomputers for individual instruction on the use of the computer and learning how the computer can be utilized in the learning environment. On a limited scale, the micro is being used for instruction and data research by using floppy disks.

With the addition of more and more micros or terminals in the classroom environment, the location of instruction may vary from what we are used to today.

The library media center could include terminals to allow the student access to data through a central computer.

Smaller areas equipped with terminals could allow for small group learning. It is possible that the traditional classroom as we know it today will disappear and students could, in fact, be given information via terminals followed by a one on one discussion time with an instructor.

By networking or connecting many individual terminals to a central computer, the same information can be given to large numbers of students without them being together in the same space or at the same time.

Some of the physical effects on the environment resulting from the addition of micros and/or terminals are:

1. Electric Power and Communication
   a. Micros - power distribution
   b. Terminals networked to main computer - more complicated due to power and communication cables.
2. Lighting
3. HVAC
   a. Heat put out by terminals will have to be taken care of by air conditioning.
   b. Micros do not put out as much heat as a terminal but, if many are grouped together, additional air conditioning might have to be considered.
4. Acoustics
   a. Printers used for terminals or micros may be distracting if used in a classroom where instruction is taking place.
5. Furniture
   a. The size of the terminal makes it difficult, if not impossible, to be laid out in a standard classroom arrangement.

Workstations with work tops and power and light can be used in independent learning environments. However, in a larger group, when visual contact by

the instructor may be desired, work tops with the terminal on top may have to be used.

6. Space Configuration and Size
7. Security

Power and Communication Cable Distribution:

The electric distribution requirements vary between micros and networked terminals. The micro can be serviced from the wall in a perimeter arrangement or from the ceiling through power poles with receptacles therein; from the floors using either an access type floor, floor outlets previously installed, or under carpet distribution.

Obviously, in an existing structure, the floor outlet is only feasible on a second floor situation where access can be obtained from the ceiling below.

The perimeter arrangement for micros can be easily arranged with the use of a Wire Mold type of distribution for standard 110v distribution. The circuiting of any of the systems should be arranged after the total number of units to be used is established.

Power Pole distribution is the easiest if there are free standing units in the center of a room. Power can be run above the ceiling in BX, rigid conduit or flexible conduit and down through the power pole to a standard outlet.

The under carpet system is a relatively new product which utilizes a flat copper "tape" system run under carpet squares. The carpet squares are used in order to allow flexibility for rearrangement in the future. Power

distribution, as well as data transmission, is possible with this system. Check local codes for all distribution systems.

When terminals are utilized as part of a local network system, the cable distribution becomes more complex.

Voice and data distribution must be considered for all networks.

Voice networks include telephone, intercom and paging. The network must include the switching equipment necessary to connect the telephones in the local network to each other and to the telephone company lines. The switching equipment for telephones is a Private Branch Exchange or PBX.

Data networks include data processing, test processing, energy control and security. All of these we see in various degrees in educational buildings.

When planning the building or space, the applicable building code should be checked to determine the requirements regarding fire code requirements of construction and materials such as cable types and locations. Other considerations are fire stops, vertical shafts, air plenums and working clearances.

Cables that tie the system parts together must be distributed throughout the building.

The main types of cable distribution systems are:

1. underfloor duct with header
2. cellular floor (with trench header)
3. unlimited access (raised) floor
4. ceiling
5. surface raceway
6. grid system above ceiling
7. cable tray

Data communication cables including the following types:

1. twisted-pair
2. shielded twisted-pair
3. coaxial
4. twinaxial
5. undercarpet cable
6. mixed conductor
7. optical fiber

The installation of power and communication cables must be in accordance with the National Electric Code including, but not limited to, power and communication cable separation, the riser system of cable distribution between floors including shafts, slots and conduit distribution, surge and lighting protection of the equipment.

If plenum spaces are utilized for return air, careful review of the code relative to material types and electrical distribution is of the utmost importance.

Acoustics:

As more electronic equipment is introduced into a space, the noises associated with the equipment may become distracting.

In large spaces that have units on tables with no subdivision of space by small workstations, the application of acoustical material in addition to the typical ceiling tile may be necessary to help reduce noise.

Panels of acoustical material wrapped in perforated fabrics or vinyl may be attached to walls or suspended vertically from the ceiling or constructed as part of free-standing partitions.

The printing mode can be the most distracting noise, but most manufacturers have acoustical covers to muffle the sound of the printer.

Other means of sound isolation include the air wall, and "white noise" or background noise to make the noise from one space to another.

Carpeting should also be considered as a floor covering in equipment rooms.

Lighting:

The lighting environment is of concern relative to comfort when reading the terminal screen or T.V. screen. Glare must be kept to a minimum as the user must sit and view a screen while using the terminal, T.V., or micro-computer. Although some screens are equipped with contrast adjustments, the glare from overhead lighting can still make the screen difficult to look at for long periods of time.

Task lighting or indirect lighting should be considered in spaces where terminals are to be utilized.

Lighting can be integrated into workstations either under cabinets or on top of partitions directing light upward to reflect off the ceiling to give an overall diffused effect with minimum shadows.

If natural lighting is utilized, careful diffusion must be included in order to control the amount of glare that may occur depending on the amount of natural light introduced into the space. If there is only a small amount of natural light through a small window, the amount of glare may be very distracting. On the other hand, if a skylight is used that distributes light evenly throughout the space and can be diffused, the light will have a uniform quality.

HVAC:

Consideration must be given to the effect of electronic telecommunication equipment on the temperature/humidity of the environment and vice-versa.

Depending on the number and type of units involved, air-conditioning of the space may have to be provided.

The micro-computer generally does not put out the high amount of heat of a terminal or computer, however, if many units are placed in an enclosed room, air-conditioning of the space is recommended.

In the case of terminals, the heat output of each unit must be determined and the A/C system designed to accommodate the added heat along with the heat output of the people and lights in the space.

The main terminal room must be completely heated and cooled and when electronic PBX is used, the manufacturer's requirements must be met for temperature, humidity and air quality.

The various space configurations that may be required by the increasing use of electronic equipment will have a profound effect on the mechanical and electrical systems of an existing building as well as a new facility in planning.

As the space becomes more flexible, the mechanical and electrical requirements of the space become critical relative to their adaptability to the changes needed.

The most difficult of these to change is the heating, ventilating and air-conditioning of the space. The electrical and cable requirements can be adapted relatively easily unless complete new service or additional cables are needed. In contrast to this, the HVAC systems can present very difficult problems when re-configuring space. This can be especially true when existing space is adapted or changed to include electronic equipment which changes the heating, ventilating and/or air-conditioning systems.

Space Configuration:

The configuration of spaces is influenced by the amount of direct interaction required between instructor and student/user of electronic communication

equipment. In many instances, as many as 30 to 35 micro-computers are placed in a single room. As the student becomes more proficient in the use of the micro or terminal and expands into using the unit as an integral part of his education, more individually controlled space may be desired and required.

Flexibility of space configuration is becoming increasingly more important as the electronic equipment changes more rapidly. Various sizes of space are necessary to provide for the different group sizes.

Space within existing buildings can be subdivided into smaller spaces by the use of site built stud and Gypsum board partitions or factory built partitions that may be of various heights from 36" to ceiling height.

If partitions run to the ceiling, the electrical cables and communication cables can be run in the partition from overhead. Fire codes relative to types of materials allowed in a plenum for cable distribution must be checked.

Existing spaces may not be able to be increased in size due to structural restrictions.

Furniture:

Furniture for the new equipment being proposed for use and being used can be broken into two categories; one consisting of tables, chairs, counters and special desks, and the other of various portable partitions of various widths, heights and arrangements that can be used in conjunction with counters and desks to form workstations for micro-computers, computer terminals and T.V.

Independent workstations of the first category can be as simple as a secretary typing run-off or work tables with chairs to a sophisticated free-standing desk that provides for adjustable keyboard height, eye-to-screen distance, viewing angle, hand-to-keyboard distance, seat height and back support.

Workstations of the second type can incorporate the adjustable qualities of the first type with partitions of various heights and configurations to establish a private or semi-private workstation.

The electric power and communication cable requirements discussed previously can be incorporated into the partitions along with telephone if necessary. Lighting can also be integrated into these workstations.

Partitions can be free-standing or fixed, however, flexibility must be considered due to the ever changing advancements of the technology.

Acoustical treatment can be built into the partitions to improve the acoustical quality of the overall space.

Security:

With the installation of expensive micro-computers, televisions, terminals, computers and cables, the security of these systems becomes a serious problem.

Security for these items falls into two categories; physical security and data security.

The physical security items include the following considerations:

1. Fire protection of terminal rooms.
2. Proper water drainage of areas.
3. If possible, keep equipment away from plumbing and areas susceptible to water damage.
4. Protect ceiling areas from water damage.
5. Install cables in raceways in areas where physical abuse may take place.
6. Keep combustible materials away from equipment.
7. Eliminate windows in equipment areas to prevent intrusion from the outside.
8. Restrict the number of keys to security areas.
9. Use optical fiber cable where possible as it is difficult to tap without detection.

The computers can also be used as part of the security system designed to protect the equipment and building.